Generator circuit breakers
About Alstom Grid

Alstom Grid, the new arm of the Alstom Group, delivers transmission solutions worldwide to utility and large industrial customers that have the need for smarter, more stable, more efficient and more environmentally-friendly electrical grids. Alstom is a global leader in the world of power generation, power transmission and rail infrastructure and sets the benchmarks for innovative and environmentally-friendly technologies. Alstom powers the fastest trains and the highest capacity automated metro in the world, providing turnkey integrated power plant solutions and associated services for a wide variety of energy sources, including hydro, nuclear, gas, coal and wind. Alstom also offers a wide range of solutions for power transmission, with a focus on smart grids. The Group employs 96,500 people in more than 70 countries, with sales of over €23 billion* in 2009/10.

*Proforma figures

Whether for installations in new power plants or for the refurbishment of existing ones, our cutting-edge technology in the field of spring-operated mechanisms offers you the perfect Generator Circuit Breaker (GCB) solution for your specific needs up to 28,000 A

Why a generator circuit breaker?

Generator circuit breakers are the ideal solution to protect and simplify power plant operations at a very low investment cost compared to the associated consequences for a power plant without generator circuit breakers.

Traditionally, power plant owners have had little option but to bear the burden of heavy loads of electricity supply, along with the price of unexpected maintenance, causing the loss of production hours. Additionally, aging power plants have to be maintained and upgraded, while new plants have to be quickly built and provide the maximum kWh. The reliability of a power plant is a major concern and there is constant pressure to avoid each hour of production loss.

One striking argument for GCBs is the protection against flash-over occurring in a step-up transformer due to an internal short-circuit. Statistically speaking, this kind of event will only occur in a small number of cases, but it can lead to severe transformer damage accompanied with long outages. Power plant output disruptions, causing loss of revenue and repair costs, are far more expensive compared to an investment in a generator circuit breaker. Additionally, the synchronisation through the GCB will prevent the premature aging of other electrical equipment due to the high electrical stresses during switching operations.

A leader in the field of high voltage circuit breakers, Alstom Grid has been manufacturing generator circuit breakers since 1972 for power plants up to 1,500 MW. More than 1,800 generator circuit breakers have been installed worldwide in applications including nuclear, hydraulic, combined cycle, gas and steam turbines, pump-storage and thermal power plants.

Our investments in R&D are significant, allowing users of our equipment to benefit from the latest technologies and innovations.
Worldwide experience

Worldwide presence
Dedicated GCB teams are located in key regions throughout the world, providing the support and expertise to assist you during the different stages of your project. Skilled Service teams are also spread throughout the world, providing immediate support, training and supervision.

Technical & commercial tendering
Our worldwide sales network covering 120 countries is there to fulfill your expectations.

Each technical specification is fully studied by the dedicated technical tendering team and every year thousands of projects are analysed and quoted, providing us with an unparalleled experience and a full overview of the generator circuit breaker field.
A competitive solution

Testing
Alstom Grid circuit breakers are type tested in first class laboratories, all members of STL (short-circuit testing liaison) such as KEMA, CERDA, CESI, EDF and are in full compliance with the latest ANSI & IEC standards.

Specific qualification processes (additional tests, specific reports, etc.) can also be performed in order to meet specific customer requirements.

All assembled generator circuit breakers are individually tested according to a dedicated procedure, based on ANSI C37.013 96.3.13 and IEC 62271-100/102 97.2 standards.
• Alstom Grid has qualified technicians piloting and controlling our automatic testing equipment (mechanical bench, tightness module, dielectric laboratories, etc.)
• Relevant acceptance criteria are defined based on detailed analyses of type tests and previous test results
• Generator circuit breaker life complies with international standards
• All delivered circuit breakers respect 100% of the standard criteria.

Production
A completely new, state of the art, industrial production line was installed in 2010, allowing the manufacturing of the GCB according to the latest industrial, safety and quality standards. An experienced and highly-qualified workforce ensure the manufacturing of Alstom Grid GCBs.
• For each step of production, detailed operational instructions are on display at the workstation, providing full availability to operators
• Complete traceability is achieved by means of monitoring sheets, labels, marks, etc.

Quality
Our R&D, production and commercial units are fully certified ISO 9001:2000. This means that during the entire production process, all employees, all equipment and all of the company’s operations are dedicated to highest quality standards and permanent improvement.
Our ISO 14001:2004 qualification certifies our commitment to sustainable manufacturing and to the limitation of environmental impacts.
In addition to the numerous standardised quality controls (R&D, type tests, purchasing quality, conformity tests on our suppliers’ parts, routine circuit breaker tests, packing, transportation, installation and commissioning), the quality process is enhanced through the application of the following:
• Supplier evaluation and selection flowchart
• Supplier type tests
• Annual inspection program which carries out tests on fully assembled generator circuit breakers taken at random from the production line, including destructive tests on separate components.

We go beyond the usual testing requirements and all of our implemented quality procedures ensure that we supply the safest and most reliable generator circuit breakers available on the market.
Design

1-Circuit breaker chamber  7-Current transformers  
2-Disconnector  8-Voltage transformers  
3-Earthling switch  9-Switch position view ports  
4-Starting switch  10-Manual short-circuiting bar  
5-Capacitors  (Single line diagram)  
6-ZnO surge arresters  11-Cooling system

Fully spring-operated mechanism
Alstom Grid has been developing and manufacturing spring-operated mechanisms since 1993, for all types of circuit breaker applications worldwide. The most recent state-of-the art evolution of these mechanisms is the FK3 range:

- The FK3 equips all Alstom Grid high voltage air and gas-insulated switchgear
- About 140,000 FK3 mechanisms are currently in operation worldwide
- The FK3 is tested and homologated for 10,000 operations and optional for 20,000 operations
- Balanced and simple kinematics enable especially stable operating times
- No adjustments required during installation phase
- Made of aluminium

Advantages

- High reliability, availability and quality
- Simple, clear functional principle
- Maximum energy stability over decades
- Minimal maintenance costs
- Oil leakage risk elimination

Interrupting chamber
To attain the highest performances while reducing spring operating mechanism energy, the Alstom Grid Research Centre has succeeded in:

- Perfecting the arcing contact design
- Developing and enhancing the thermal effect
- Optimising the puffer effect thanks to a specific guiding nozzle

We design our entire range of generator circuit breakers with two interrupting chamber types: FKG1 (horizontal) and FKG2 (vertical).
Components

**Disconnector (SKG)**
The disconnector is a mechanical switching apparatus which provides an isolating distance in the open position that can be checked visually:
- The disconnector continuously carries the rated current
- The disconnector is designed to withstand the rated voltage
- The disconnector withstands the rated short-time current during 1s
  (or more upon request)

**Earthing switch (MKG)**
The earthing switch is a mechanical switching device which allows a direct link of the apparatus to the enclosure and so to the earth, in order to secure the system before maintenance interventions:
- The earthing switch withstands the rated short-time current during 1s
  (or more upon request)
- The earthing switch is designed to withstand the rated voltage

**Starting switch (IKG)**
The starting switch is a current injector mechanically linked to the Static Frequency Converter (SFC). It allows temporary supply to the alternator in order to operate as a motor: it injects permanent current from the outside to the inside of the apparatus in order to start the alternator and the gas turbine.

**Capacitor**
A capacitor can be used to reduce the rate of rise of recovery voltage. It is installed between phase and earth. Capacitors used for GCBs are fixed on the enclosure support. The capacitor is always located on the transformer side to help to break the system-source short circuit current.*
* Under specific conditions another capacitor could be installed on the generator side.

**Surge arrester**
Zinc Oxide (ZnO) surge arresters are effective solutions to protect equipment against lightning and switching impulses. They are installed in the GCB enclosure on the transformer side.
Current transformer
A current transformer (CT) is a measurement device designed to provide a galvanic insulation between high voltage and low voltage equipment (security function) and to provide a current in its secondary winding(s) proportional to the current flowing in its primary. Current transformers are commonly used in metering and protective relays in the electrical power industry. The CTs are installed in the GCB enclosure to secure the power plants and networks while ensuring the electrical energy supply (transmission) and providing a permanent data flow on the current(s).

Voltage transformer
Voltage transformers (VTs) or potential transformers (PTs) are a type of instrument transformer used for metering and protection in high voltage circuits. They are designed to present negligible load on the supply being measured and to have a precise voltage ratio to accurately step down high voltages, so that metering and protective relay equipment can be operated at a lower potential. The VTs are installed in the generator circuit breaker enclosure; they are single-phase and connected between phase and earth.

Cooling system
Alstom Grid has developed several cooling system technologies to equip its generator circuit breaker product range, such as natural and enhanced air solutions. These external cooling systems are purely redundant and inspired from our experience in GCB for nuclear power plants. The logical design continuously ensures supervision and takes all necessary actions to ensure full GCB availability.

Interlocking system
An interlocking system is provided for the GCB, the disconnector, the earthing switches and the starting switch. The key interlocks are mechanical and electrical, which lock the closing or opening functions on the GCB, disconnector, earthing switch and starting switch. The sequential interlocking system ensures full safety during GCB operation and maintenance. Dangerous operations are electrically and mechanically locked.
Option
In addition to standard product components, we develop optional systems to improve and optimise the monitoring and maintenance of generator circuit breakers.

**CBWatch-2 monitoring system**

The CBWatch-2 is a combination of new monitoring and maintenance optimisation tools accessible via web-based technology.

The CBWatch-2 is installed in the GCB control panel and maintains a constant, monitored link with a local or remote database via the CBWatch Tool software. The monitoring system records information coming from the sensors installed on the breaker, then analyses the information, comparing it with standard operational parameters programmed into the system.

The CBWatch-2 monitoring system offers customers a proactive and more cost-effective maintenance programme by constantly supervising generator circuit breaker conditions and trends within operational parameters such as:

- $SF_6$ supervision
- Breaking supervision
- Supervision of the auxiliary and control circuits
- Supervision of the spring-loaded control mechanism
**Application**

With energy markets undergoing major and rapid changes, electricity suppliers need solutions for peak performance and cost-effectiveness.

**Pump storage**

With a world capacity of more than 100 GW and a growing awareness of the impact of the production of electricity on CO2 emissions, pump storage power plant development has been widely encouraged to store energy more efficiently. As a GCB manufacturer, we can offer a complete solution for the GCB, phase reverse, braking, starting and back-to-back disconnectors. For this specific application, the circuit breaker will be warrantied for 20,000 CO, to ensure the heavy daily mechanical loads.

**Retrofit**

Many of today’s power plants are more than 20 years old and the need to extend the life of existing power plants is increasing in today’s economic and energy climate. For this reason, refurbishment is needed to renew the power plant by replacing the generator circuit breaker and all equipment around the GCB, such as the Isolated Phase Bus duct (IPB) and its environment in the station. Old generator circuit breakers require maintenance times that are expensive when power plants produce hundreds of MW. They could also need spare parts that are ever harder to obtain.

Our generator circuit breaker team has developed a pertinent retrofit offer, which fits the criteria of reliability, adaptability and availability. From the site survey to erection, adapted to the available space, existing bus bars and civil engineering, Alstom Grid proposes an integrated offer for the utmost time and cost optimisation.
Proven technology
A superior range of generator circuit breakers to fit your requirements

Alstom Grid offers you the perfect generator circuit breaker solution for installation in new power plants or for refurbishment of existing ones. All generator circuit breakers are designed to meet the customer’s specific needs. Both circuit breaker-only and combined solutions are available.

* For more information, please contact us.
With more than 1,800 generator circuit breakers installed and in service throughout the world over the past 40 years, we are recognised as the technological leader ensuring the reliability and safety of your operations at an optimised cost.